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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

MAILED

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Technology Center 2100

Application Number: 10/608,300
Filing Date: June 27, 2003
Appellant(s): DODDI ET AL.

Peter Yim
For Appellants

EXAMINER'S ANSWER

This is in response to the appeal brief filed February 12,2007 appealing from the Office action mailed August 11, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(1) Real Party in Interest

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellants' statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellants' statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

Singh et al. (USPN 6,650,422 B2).

Wormington et al. (USPN 6,192,103 B1).

Kato (USPN 6,665, 446 B1).

(U.S. Patent 5,793,480. col. 2, lin.35-42).

Sirat et al. (EPN 0 448 890 A1).

Hassoun, "Fundamentals of Artificial Neural Networks, 1995, p. 440.

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 1-6, 9-15, and 16-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over *Singh et al.* (USPN 6650422 B2) in view of *Wormington et al.* (USPN 6,192,103 B1).

Regarding claim 1. *Singh et al.* describe a method of examining a structure formed on a semiconductor wafer (*see* col. 2, lines 14-17), the method comprising: obtaining a first diffraction signal measured using a metrology device (*see* col. 3, lines 8-12); obtaining a second diffraction signal (*see* col. 3, lines 12-15); comparing the first and second diffraction signals (*see* col. 3, lines 12-15); and when the first and second diffraction signals match within a matching criterion, determining a feature of the structure based on the one or more parameters or the profile (*see* col. 3, lines 15-17). *Singh et al.* do not describe obtaining a second diffraction signal generated using a machine learning system, wherein the machine learning system receives as an input one or more parameters that characterize a profile of the structure to generate the second diffraction signal. *Wormington et al.* describe obtaining a second diffraction signal generated using such a machine learning system (*see*, Fig. 6 and col. 8, lines 37-40 and col. 5, lines 50-62, *Examiner asserts that genetic and evolutionary algorithms are machine learning algorithms.*). It would have been obvious at the time the invention was made, to persons having ordinary skill in

the art, to combine *Singh et al.* with *Wormington et al.* to construct the reflectance signature database with virtually no user intervention (*see* col. 4, lines 8-15).

Regarding claims 2-3. *Singh et al.* describe the method, further comprising: prior to generating the second diffraction signal, training the machine learning system using a set of training input data and a set of training output data, wherein each of the training input data is a profile of the structure characterized by one or more parameters, and wherein each of the training output data is a diffraction signal corresponding to the profile of the structure (*see* col. 9, lines 7-13).

Regarding claim 3. Selecting the set of training input data from a range of profiles of the structure is inherent in the method in that: prior to using the machine learning system (that is a neural network) it must to be trained. Further, the training input and output data must be selected before training can be conducted. Singh teaches that the database of signatures associated with known feature profiles maybe utilized to input training data (*see* col. 9, lines 8-10).

Regarding claim 4. Singh teaches dividing the range of profiles into two partitions. (*see* col.2, lines 25-36). Hence it is inherent to choose two machine-learning systems to learn both partitions under the context set forth by Singh using selected input training data described in claim 3.

Regarding claims 5-6. The admitted prior art on page 1 of the specification [0003]states that the diffraction beam (the output training data) can be analyzed using modeling techniques such as wave analysis.

Regarding claims 9-10 and 15. *Kato* (USPN 6,665, 446 B1) teaches (col. 10, lines 28-32) that neural networks and genetic algorithms are art equivalents and the basic training of a neural network inherently consists of getting input training data, comparing output data with desired values, and acting accordingly with the comparison. Official Notice is taken of the use of a back-propagation algorithm in a neural network.

Regarding claims 11-12. Singh uses the first diffraction signal to compare with profiles in database (col. 3, lines 10-16). Singh also states that the database can be use to train a neural network (col. 9, lines 7-15) that will replace database to generate diffraction signals to Compare.

Regarding claims 13-14. Official notice is taken that metrology device is used to measure structure such as ellipsometer using dimension measurement such as n and k values. (See U.S. Patent 5,793,480. col. 2, Iin.35-42)

Regarding claims 16-29. Claims 16-21 are computer program claims that implement method claims 1-15 using instruction code and claims 22-29 are systems claims that implement method claims 1-15 using various devices and computers. Therefore claims 16-21 and claims 22-29 are rejected under the same rationale as cited in the rejection of rejected claims 1-15.

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Singh et al.* in view of *Wormington et al.* as set forth above and in view of *Sirat et al.* (EPN 0 448 890 A1).

Regarding claim 7. Using principal component analysis to transform machine-learning system output data is taught (*see* p. 2, lines 39-41) by *Sirat et al.* It would have been obvious at the time the invention was made, to persons having ordinary skill in the art, to combine *Singh et al.* with *Sirat et al.* to obtain fewer and simpler calculations per iteration during training.

(10) Response to Argument

Appellants' arguments filed October 11, 2006 have been fully considered but they are not persuasive.

With respect to those claims rejected, Appellants' argue that:

1. New Parameter Vector is Output of Genetic and Evolutionary Algorithms in Wormington Reference

2. Singh Reference Fails to Disclose Diffraction Signal Generated Using Machine Learning System.

Examiner will show that both Appellants' and *Singh* in view of *Wormington* teach using a machine learning system to generate a simulated diffraction signal (i.e., a parameter vector). Examiner follows Appellants' order of argumentation.

A. Claims 1-6, 11-14, and I6-29

Appellants argue:

> The Examiner rejected Claims I-6, 11-14, and 16-29 under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent No. 6,650,422 (the Singh reference) in view of U.S. Patent No. 6,192,103 (the Wormington reference).
>
> Independent claims 1, 16, and 22 recite that the second simulated diffraction signal is generated as an output of the machine learning system. Note, claims 1, 16, and 22 do not merely recite that the second simulated diffraction signal is generated as an output, or that the machine learning system is used in generating the second simulated diffraction signal. Instead, claims 1, 16, and 22 expressly recite that the output of the machine learning system is the second simulated diffraction signal. Applicants assert that the Examiner is making a clear error by failing to establish where this claim element is disclosed in the Wormington reference.
>
> 1. New Parameter Vector is Output of Genetic and Evolutionary Algorithms in Wormington Reference
>
> The Examiner has asserted that the X-ray scattering disclosed in the Wormington reference corresponds to the second simulated diffraction signal recited in claims 1, 16, and 22. Additionally, the Examiner has asserted the genetic and evolutionary algorithms disclosed in the Wormington reference correspond to the machine learning system recited in claims I, 16, and 22.
>
> Thus, to be logically consistent, the Examiner must establish that the X-ray scattering disclosed in the Wormington reference is generated as an output of the genetic and evolutionary algorithms. It is not sufficient to simply establish that X-ray scattering is produced as art output because claims 1, 16. and 22 explicitly recite that the second simulated diffraction signal (which the Examiner has asserted corresponds to the X-ray scattering) is an output of the machine learning system (which the Examiner has asserted corresponds to the genetic and evolutionary algorithms).

The Wormington reference discloses using a genetic algorithm, particularly an evolutionary algorithm, to form a new parameter vector from two parameter vectors (see e.g. col. 3, lines 48-52) and not a diffraction signal. Thus, the output of the genetic algorithm is a new parameter vector rather than the X-ray scatter/rig.

Examiner responds:

Appellants have shown that Wormington's invention uses parameter vectors which act as diffraction signals. Examiner notes that Appellants also disclose the use of parameter vectors, called profiles, in various paragraphs in the Specification. See for instance, para. 0020

> [0020] More specifically, each diffraction signal in the library is associated with a profile of the structure.

and para. 0022

> [0022] The set of profiles stored in library 116 can be generated by characterizing a profile using a set of parameters, then varying the set of parameters to generate profiles of varying shapes and dimensions. The process of characterizing a profile using a set of parameters can be referred to as parameterizing.

Reference may also be made to para.: 0024, 0025, 0028, 0035, 0044, 0055, and 0059. Simply put, Appellants' invention creates a set of parameters and the invention of Wormington creates a set of parameters and it is these parameters that are matched. There are no actual diffraction signals in the computer until a transformation is made, in each case, to the parameters that represent the signal.

Clearly, there is no difference between Appellants and Wormington in the representation of diffraction signals.

Appellants argue:

> In the final Office Action, the Examiner states that, "Applicant's argument that Wormington et al. don't generate a simulation of X-ray scattering as output at 40 ignores the fact that step 40, as depicted in Fig. 4, is not an output step." Applicants believe that the Examiner has misunderstood the Applicants' argument.
>
> Applicants' argument with regard to the output of step 40 in FIG. 4 was to establish that the Wormington reference discloses that the output of the genetic algorithm is a new parameter vector rather than an X-ray scattering. Whether or not the output of step 40 is the ultimate output of the process depicted in FIG. 4 is not relevant to the issue at hand (i.e., determining what is the output of the genetic algorithm disclosed in the Wormington reference).
>
> Clearly when a step of a process is performed, there is an output of that step, even if that output is not the ultimate output of the process.

Examiner responds:

One of the most often executed steps found in working programs is: 'increment the accumulator'. This step is used to count the number of times loops are performed. The accumulator increment operation produces no output. To break out of a loop, a program compares the contents of the accumulator to some value held in a register. Clearly, Appellants' assertion that "when a step of a process is performed, there is an output of that step" is generally false. Since we cannot rely on the existence of output produced by any step of a program or algorithm, it is critical to discern where in a program output occurs, or is supposed to occur. This is one of the things a flowchart shows with an 'input/output box' (i.e., parallelogram) (*see* http://www.edrawsoft.com/flow-chart-design.php). Appellants' argument below is dependent on such discernment. Neither

Appellants' Fig. 4 nor Wormington's Fig. 4 show a diffraction signal in an input/output box.

Appellants argue:

> In particular, step 40 is to "ADJUST MODEL PARAMETERS." Thus, adjusted model parameters are the output of having performed step 40. Similarly, step 34 is to "COMPUTE SIMULATION." Thus, a computed simulation is the output of having performed step 34. Because step 34 is performed before step 40, the computed simulation exists before the adjusted model parameters.

Examiner responds:

Neither step 40 nor steps 34 are indicated in the flowchart, with standard symbols, to produce output. Thus, the computed simulation is deemed to be merely the *result* of having performed step 34. Further, Appellants' argument that "Because step 34 is performed before step 40, the computed simulation exists before the adjusted model parameters." ignores the fact that step 34 comes *after* step 32, in which the model parameters are estimated from "X-ray scattering data for a specimen being tested" (*see* col. 6, lines 5-8). Thus, the first time through the loop, the computed simulation exists *after* a computation of the model parameters at step 32. Thereafter, because control is in a loop, the computed simulation exists *after* a computation of the model parameters at step 40.

Appellants argue:

> Column 6, lines 14-16 clearly disclose that the computed simulation generated as an output of step 34 is the X-ray scattering.

Examiner responds:

Column 6, lines 14-16 recite: "Once the model has been estimated, the X-ray scattering, for that model is simulated at step 34, using known methods…". Since neither the text nor the flowchart indicate an 'output', the inference of such, on the part of the Appellants, is problematic.

Appellants argue:

Column 8, lines 3-7, discloses, "the adjustment of the model parameters at step 40, to obtain the best fit, is carried out with the use of genetic algorithms." Thus, the X-ray scattering (corresponding to step 34) exists before the genetic algorithm is used to adjust the model parameters (corresponding to step 40). Thus, X-ray scattering (which the Examiner has asserted corresponds to the second diffraction signal) can not be the output of the genetic algorithm (which the Examiner has asserted corresponds to the machine learning system).

Examiner responds:

Genetic algorithms do more than adjust parameters (*see* Wormington, column 8, lines 7-17). Genetic algorithms test whether a chromosome (i.e., vector) maximizes (or minimizes) some fitness function. The test in Wormington is clearly at step 38, thus the boundary of the genetic algorithm is not at step 40. Another thing that genetic algorithms do is establish initial populations (*see* Hassoun, "Fundamentals of Artificial Neural Networks, 1995, p. 440, "To start the genetic search, an initial population…is created."). Wormington teaches that: "In the context of X-ray scattering, therefore, the initial population comprises various sets of the parameters that are used to characterize a specimen." (*see* col. 8, lines 14-17). Examiner interprets "the initial population" to be

simulated data created at step 34. Therefore, step 34 is functionally part of the genetic algorithm. Thus, the data representing two (or more) X-ray scatterings (or diffraction signals) is clearly a result of computations inside the genetic algorithm of Wormington's invention and *could* be indicated to be the output of the genetic algorithm with the appropriate flowchart symbol.

Examiner, therefore, maintains the rejection of claims 1, 16, and 22 as well as claims 2-6, 11-14, 17-21, and 23-29. Appellants have not provided a separate argument for the patentability of the claims 2-6, 11-14, 17-21 and 23-29; therefore these claims are considered to be unpatentable as well.

Appellants argue:

2. Singh Reference Fails to Disclose Diffraction Signal Generated Using Machine Learning System.

B. Claims 9-10 and 15

The Examiner rejected claims 9-10, and 15 under 35 U.S.C. 103(a) as being unpatentable over the Singh reference in view of the Wormington reference and further in view of US Patent No. 6,665,446 (the Kato reference).

The rejection of claims 9-10 and 15 should be withdrawn for at least the reason that they depend on an allowable independent base claim.

Examiner responds:

The independent base claim 1 is not considered to be patentable. It is not considered that Appellants have provided a substantive argument for the patentability of this claim; therefore, it is not considered to be patentable in as much as claim 1 is not patentable.

C. Claim 7

Appellants argue:

> The Examiner rejected claim 7 under 35 U.S.C. 103(a) as being unpatentable over the Singh reference in view of the Wormington reference and further in view of EP Patent No. 0 448 890 (the Sitar et al. reference).
>
> The rejection of claim 7 should be withdrawn for at least the reason that it depends on an allowable independent base claim.

Examiner responds:

The independent base claim 1 is not considered to be patentable. It is not considered that Appellants have provided a substantive argument for the patentability of this claim; therefore, it is not considered to be patentable in as much as claim 1 is not patentable.

D. Claim 8

Appellants argue:

> The Examiner rejected claim 8 under 35 U.S.C. 103(a) as being unpatentable over the Singh reference in view of the Wormington reference and further in view of Gahegan et al "Dataspaces as an organizational concept for the neural classification of geographic datasets", 1999.
>
> The rejection of claim 8 should be withdrawn for at least the reason that it depends on an allowable independent base claim.

Examiner responds:

The independent base claim 1 is not considered to be patentable. It is not considered that Appellants have provided a substantive argument for the patentability of this claim; therefore, it is not considered to be patentable in as much as claim 1 is not patentable.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

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Conferees:

Kamini Shah (Appeals Specialist)

Anthony Knight (SPE)

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